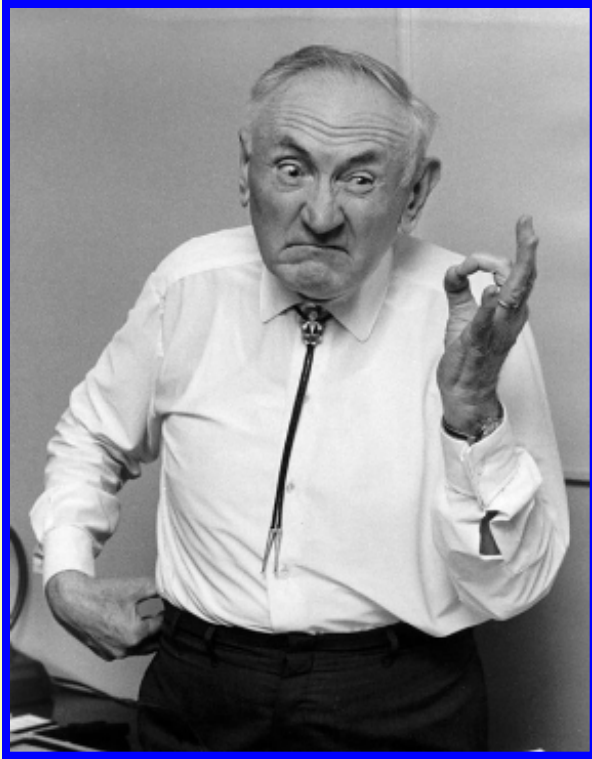


***Strategic  
Decision Support Modelling  
with  
Morphological Analysis***

Report Documentation Page			Form Approved OMB No. 0704-0188		
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE <b>JUN 2005</b>		2. REPORT TYPE		3. DATES COVERED <b>00-00-2005 to 00-00-2005</b>	
4. TITLE AND SUBTITLE <b>Strategic Decision Support Modeling with Morphological Analysis (Briefing Charts)</b>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>Swedish Defence Research Agency,FOI,SE-172 90 Stockholm, Sweden, ,</b>				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES <b>The original document contains color images.</b>					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES <b>27</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			



# Fritz Zwicky

1898-1974

Professor of Astronomy (1942-1968)  
California Institute of Technology

Co-founder of Aerojet Engineering

President of "International  
Academy of Astronautics"

- Discovered evidence for "dark matter" in galaxies (1933)
- Triple-hypothesis: *supernova, neutron stars & cosmic rays* (1934)
- Galaxies and galaxy clusters act as gravitational lens (1937)
- Developed **morphological analysis** as a general method for non-quantified modelling using a "*morphological field*"

## **“Wicked problems”**

H. Rittel & W. Melvin (1973). "Dilemmas in a General Theory of Planning", *Policy Sciences* 4, Elsevier Scientific Publishing, Amsterdam, pp. 155-169.

## **“Social messes”**

Russel Ackoff: (1974). *Redesigning the Future*, Wiley.

# ***What's the problem ?***

**Mess**



**Problem**

**= Complex issue which is not well formulated or defined. (“Wicked problems”)**

**= Well formulated/defined issue, but with no single, clear-cut solution (various solutions depending on...)**

**Puzzle**

**= Well defined problem with a specific solution which can be worked out.**

"One of the greatest mistakes that can be made when dealing with a mess is to carve off part of the mess, treat it as a problem and then solve it as a puzzle -  
- ignoring its links with other aspects of the mess."

(Pidd, M: *Tools for Thinking*, 1996)



# ***Morphological Analysis:***

**A GENERALISED METHOD FOR STRUCTURING  
AND ANALYSING COMPLEX PROBLEM FIELDS  
WHICH:**

- **ARE INHERENTLY NON-QUANTIFIABLE**
- **CONTAIN NON-RESOLVABLE UNCERTAINTIES**
- **CANNOT BE CAUSALLY MODELLED OR  
SIMULATED**
- **REQUIRE A JUDGMENTAL APPROACH**

# ***For What ?***

## **LONG-TERM PLANNING and STRATEGY EVALUATION**

- **DEVELOPING SCENARIO MODELLING  
LABORATORIES**
- **STRUCTURING AND ANALYSING COMPLEX  
POLICY SPACES**
- **RELATING ENDS & MEANS IN STRATEGIC  
PLANNING (Process support for decision-making)**
- **“POSITION ANALYSIS” (STAKEHOLDER ANALYSIS)**



# ***Philosophy:***

## **THE METHOD SHOULD BE:**

- Group & process oriented
- Generic (general method for NQM)
- Transparent (No black boxes)
- Traceable ("Audit trail")
- Easy to update results

# ***Results:***

- A structured (dimensioned) problem
- Simple (scenario) laboratory
- Complex overlay laboratory
- Validated IO-model/instrument

# ***For whom ?***

## **Swedish Total-Defence Structure**

- **Scenarios and Strategies for Long-term Planning**
- **Airborne Capacity\***
- **Amphibious Brigade**
- **Future ground target systems\***
- **UAV Tactical Systems**
- **Markus: The Future Ground Soldier**
- **New Education and Training Systems for the Army**
- **Swedish SEAD Capacity**
- **Information Warfare Systems and Contexts (CSIR)**
- **Instrument for Evaluating Military Exercises**
- **Risk Analysis for UXO**

# ***For whom ?***

## **Civilian Agencies, NGOs and Companies**

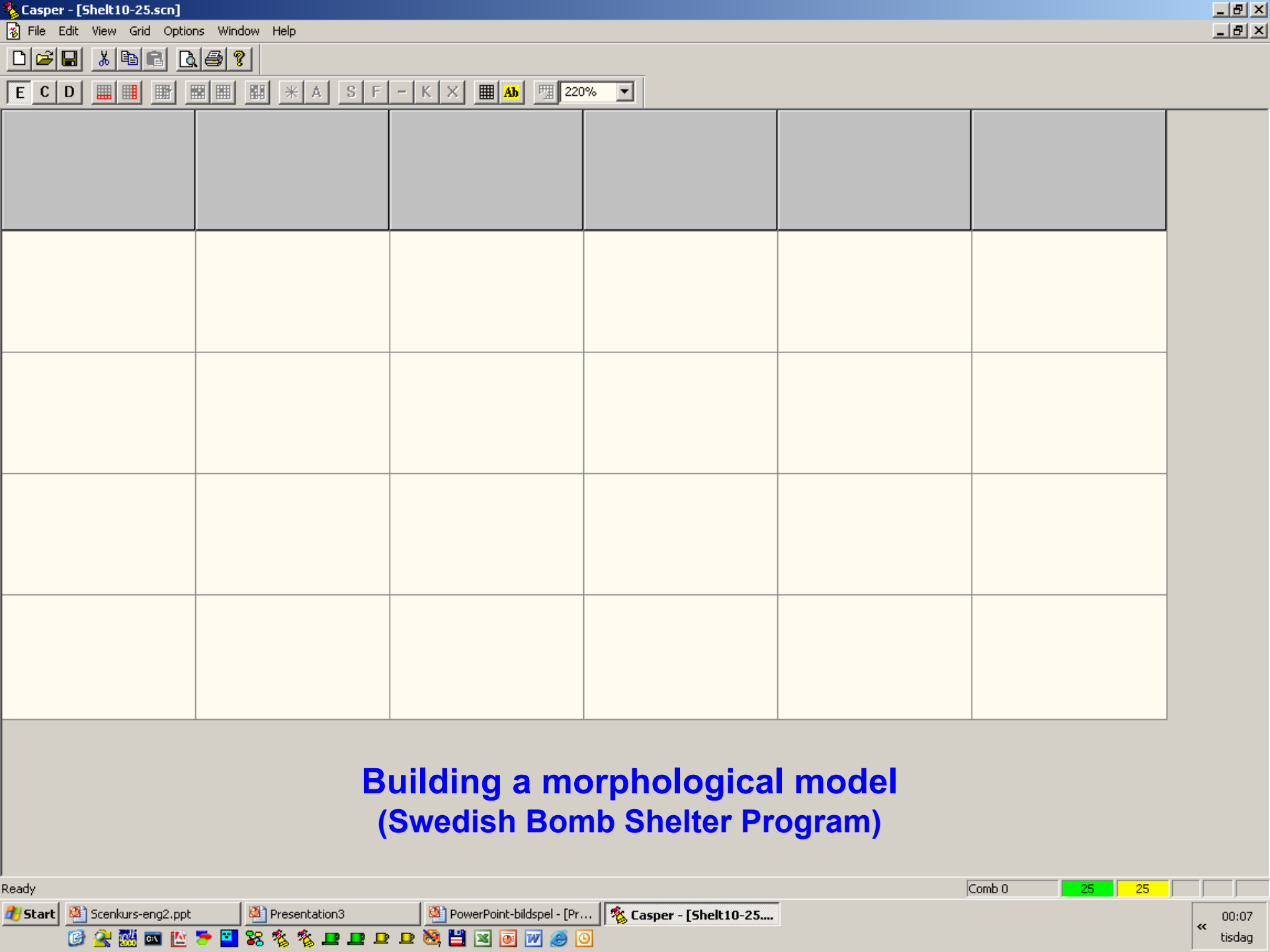
- **National Rescue Services (SRV)**
- **Environmental Protection Agency (EPA)**
- **Foreign Aid and Development Agency (SIDA)**
- **Swedish Energy Agency (Stem)**
- **Nuclear Waste Disposal Agency (SKB)**
- **Nuclear Power Inspectorate (SKI)**
- **Swedish Postal Services**
- **CSIR – Republic of South Africa (IW)**
- **Center for Science, Policy, Outcomes – Washington DC**

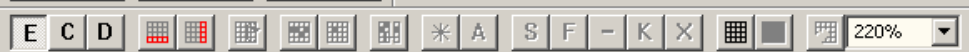
# Ground Target Model: scenarios vs. systems

Tactical scenarios	Purpose	Effect/ penetration: What required	Effect/ precision: What required	Guidance system: final phase	Attack attitude: What required	Time to effect after decision to employ	Special weapon system demands/properties	System
Scenario 1	Destroy	Bunker buster	Great accuracy Little or no side effect	Visuellt	Vertical	Within 10 s	Recognition/ identification capacity	System 1
Scenario 2	Pin down, stop	Kinetic energy + RSV (Hard)	Great accuracy Limited side effect	IR	Horizontal	Within 1 minute	Command self-destruction (Abort mission)	System 2
Scenario 3	Disrupt	30 mm (medium)	Good accuracy Some side effect	Radar		Within 10 minute	Updateable target co-ords.	System 3
Scenario 4	Warn	Small-bore + fragmentation (soft)	Area effect 200x300 m	Akustisk		Within 30 minute	Sensor guided warhead	System 4
Scenario 5			Area effect 500x400 m	Koordinatbestäm.		Within 1 hour	Pre-programmed target co-ords.	System 5
Scenario 6						Within 5 hours	Basic capacity	System 6
Scenario 7						Within 24 hours		System 7
						More than 24 hours		System 8
								System 9
								System 10
								System 11

Morphological model containing 38,000 possible configurations







**Define the most important parameters of the problem complex**

## Define the most important parameters of the problem complex

Casper - [Shelt10-25.scn]					
File Edit View Grid Options Window Help					
<div> <div> </div> <div> E C D <div> </div> <div> </div> <div> 220% </div> </div> </div>					
Geographic priority	Functional priorities	Size and cramming	New construction	Maintanance	General philosophy
Metropolises	All socio-tech. functions	Large, not cramped	With new construction	More frequent maintainance	All get same shelter quality
Cities + 50,000	Tech. support systems	Large & cramped	Compensation	Current levels	All take same risk
Suburbs and country-side	Humanitarian aims	Small, not cramped	New only for defence build up	No maintainance	Priority: Key personnel
No geo-priority	Residential	Small & cramped			Priority: Needy
Define a range of “values” or “conditions” for each parameter					
<div> <div>Ready</div> <div> <div>Start</div> <div>Scenkurs-eng2.ppt</div> <div>shelter25.ppt</div> <div>Casper - [Shelt10-25....</div> </div> <div> <div> </div> <div> 00:35 tisdag </div> </div> </div>					



## A field configuration (one of 2304)

Geographic priority	Functional priorities	Size and cramming	New construction	Maintanance	General philosophy
<del>Metropolises</del>	All socio-tech. functions	Large, not cramped	With new construction	More frequent maintainance	All get same shelter quality
<del>Cities + 50,000</del>	Tech. support systems	Large & cramped	Compensation	Current levels	All take same risk
<del>Suburbs and country-side</del>	Humanitarian aims	Small, not cramped	New only for defence build up	No maintainance	Priority: Key personnel
No geo-priority	Residential	Small & cramped			Priority: Needy

Contradictory value pairs

Geographic	Functional	Size and	New	Maintana
Metropolises				
Cities + 50,000				
Suburbs and exurbs				
No geo-priority				
High-tech, high functions				
High support systems				
Humanitarian claims				
Residential				
Large, not overcrowded				
Large & overcrowded				
Small, not overcrowded				
Small & overcrowded				
With new construction				
Compensation				
For defence build-up				
Frequent maintenance				
Current levels				
Maintenance				

Functional priorities	All socio-tech.																								
	Tech support																								
	Humanitarian																								
	Residential																								
Size and cramming	Large, not																								
	Large &																								
	Small, not																								
	Small &																								
New construction	With new																								
	Compensation																								
	New only for																								
Maintanance	More frequent																								
	Current levels																								
	No																								
General philosophy	All get same																								
	All take same																								
	Priority: Key																								
	Priority: Needy																								

Casper - [Shelt10-25.scn]

File Edit View Grid Options Window Help

E C D 
 
 \* A S F - K X 
 
 220%

Geographic priority	Functional priorities	Size and cramming	New construction	Maintanance	General philosophy
Metropolises	All socio-tech. functions	Large, not cramped	With new construction	More frequent maintainance	All get same shelter quality
Cities + 50,000	Tech. support systems	Large & cramped	Compensation	Current levels	All take same risk
Suburbs and country-side	Humanitarian aims	Small, not cramped	New only for defence build up	No maintainance	Priority: Key personnel
No geo-priority	Residential	Small & cramped			Priority: Needy

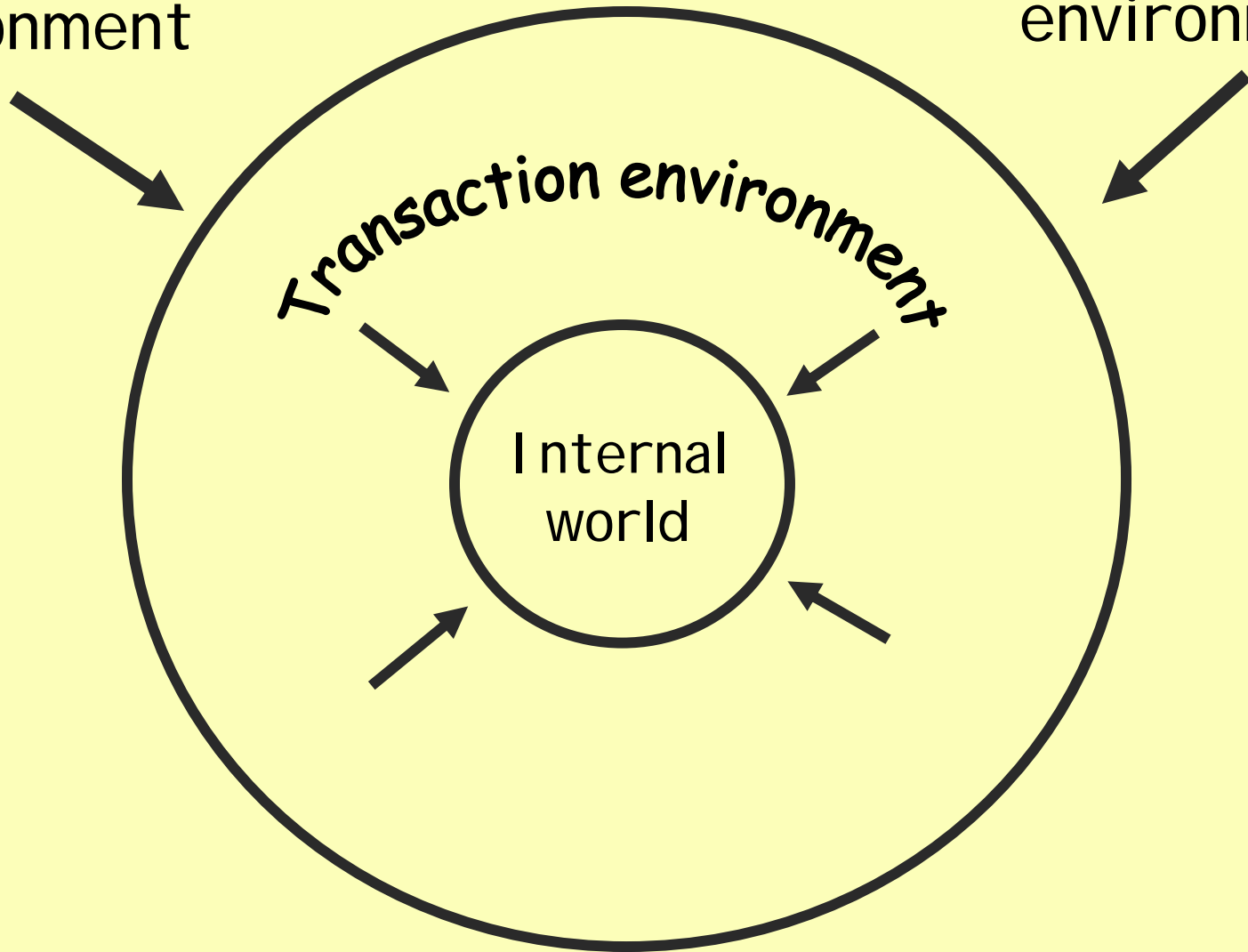
Scene Lis...

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14
- 15
- 16
- 17
- 18
- 19
- 20
- 21
- 22
- 23
- 24
- 25

**Solution space: list of surviving, internally consistent configurations**

Contextual  
environment

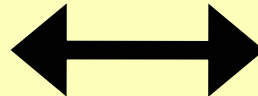
Contextual  
environment



# ***Linked morphological fields:***

Scenario field

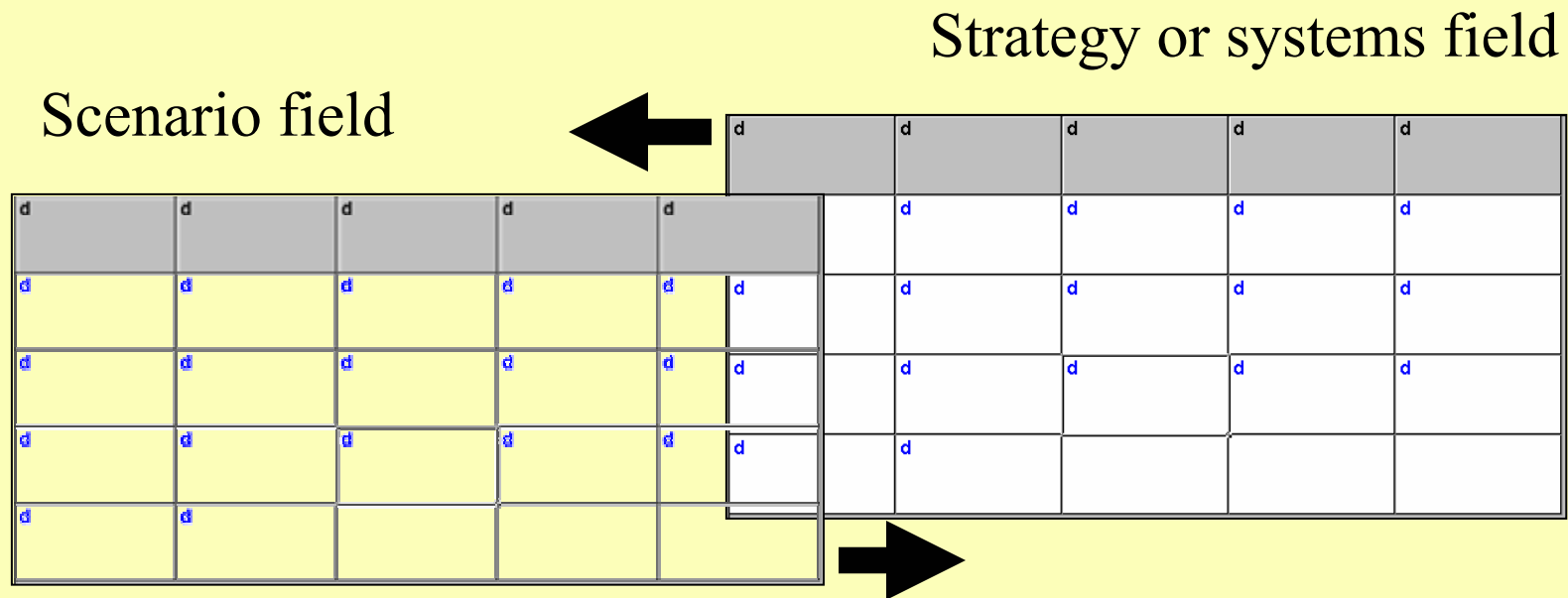
d	d	d	d	d
d	d	d	d	d
d	d	d	d	d
d	d	d	d	d
d	d			



Strategy or systems field

d	d	d	d	d
d	d	d	d	d
d	d	d	d	d
d	d	d	d	d
d	d			

# Scenario-Strategy overlay:



# Examples



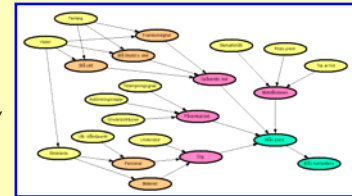
# Three methods for strategic decision support modelling

MA

Geografisk prioritering	Funktionell prioritering	Storlek och trängsel	Nybyggande	Underhåll	Skyddsområde
Endast större områden	Alla socio-ekonomiska funktioner	Stora, tv-tränga	Med ny konstruktion	Med beaktande	Alla för samma skydd
Städer med minst 50.000	Enkelt uttryck	Stora, tv-tränga	Kompensation för funktionsförlust	Enkelt uttryck	Alla för samma risk
Förorter och småstaden	Enkelt uttryck	Stora, tv-tränga	Enkelt uttryck "Befolkning"	Enkelt uttryck	Funktionell uttryck, enkelt uttryck
Ingen geografisk prioritering	Enkelt uttryck	Stora, tv-tränga		Enkelt uttryck	Enkelt uttryck

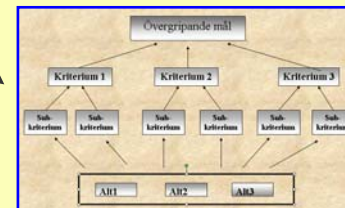
Structure (parameterise)  
a problem complex  
("wicked problems")

BN



Causal  
network model

AHP



Evaluate  
alternatives given  
a hierarchy of  
goal criteria

# Information on General Morphology

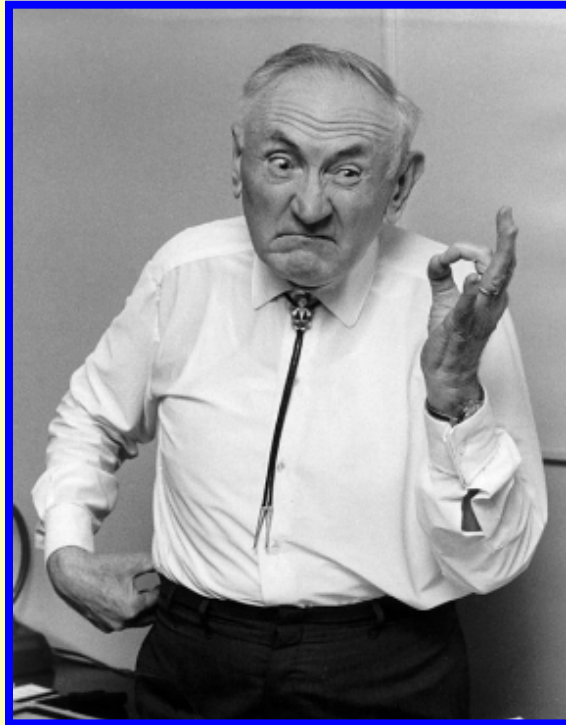
-----

[www.foi.se/ma](http://www.foi.se/ma)

[www.swemorph.com](http://www.swemorph.com)

[ritchey@foi.se](mailto:ritchey@foi.se)

***Thank you ...***



***and have a nice day...***

